a9 cont

same total signal power to one mobile terminal 16 at a time from the best base station 12 with the same channel state to obtain the comparative gain or loss for the macrodiversity network 10. In the above case, the results were:

Mobile 1: +4.46dB more power needed (a loss)

Mobile 2: +0.98dB more power needed (a loss)

Mobile 3: +2.50dB more power needed (a loss)

The net loss is less than appears, because the mobile terminals 16 that are relatively nearer their supporting base stations 12 receive the significantly increased power while those further away receive smaller power increases.

Remarks

The above amendments involve four main areas of correction. First, the changes to pages 22, 23, 33, and 40 correct minor typographical errors. Next, the changes to pages 10, 34, and 35 correct minor errors to the equations. In particular, the final element in the equation in the first paragraph on page 10 should read $C_{n-1}z^{-(n-1)}$, which follows the general pattern of the preceding elements. The correction to Equation 15 replaces $z^{-3}-z^{-2}$ in column 3, row 2 with the correct entry $z^{-4}-1$, which is the proper entry for the identified adjoint matrix calculation. Lastly, the correction to Equation 16 replaces z^{-2} in column 3, row 2 with the correct entry $1+z^{-1}+z^{-2}+z^{-3}$, and corresponds to the correction made to Equation 15.

The third main area of correction involves Table 3 on page 39. The original table was missing the line separating the column containing the imaginary roots from the column containing logmagnitude of the roots. The correction to Table 3 inserts the column separator and corrects the column labels accordingly. All of the numerical entries in the table remain the same.

The last main area of correction involves the corrections to page 20 and the corrections to Figures 1 and 6. Applicant submits redlined corrections to Figures 1 and 6, as well as formal drawings that incorporate these changes. The corrections to Figure 1 update the reference numbers for base stations 12, antennas 14, and mobile terminals 16 to correspond with the specification's use of letter suffixes for different ones of similar or like objects. Namely, the reference numbers now indicate base stations 12A, 12B, and 12C, antennas 14A, 14B, and 14C, and mobile terminals 16A, 16B, and 16C. In addition, page 20 changes modulators 22 to modulators 22A … 22N to correspond with the modulators referred to in Figure 2 and referenced in corrected Figure 1.

Attached hereto is a marked-up version of the changes made to the specification by the current amendment. The attachment is captioned **"Version with Markings to Show Changes Made."**

Respectfully submitted,

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CERTIFICATE OF MAILING

I HEREBY CERTIFY THAT THIS DOCUMENT IS BEING DEPOSITED WITH THE UNITED STATE POSTAL SERVICE, ON THE DATE INDICATED, AS FIRST CLASS MAIL, POSTAGE PREPAID, IN AN ENVELOPE ADDRESSED TO: **COMMISSIONER FOR PATENTS, BOX NON-FEE AMENDMENT, WASHINGTON, D.C. 20231**

Signature: Kathleen Kopke

Date: 11/26/02

Version with Markings to Show Changes Made

Amendments to the paragraph beginning on line 1 of page 10.

Typically, the propagation channel between a given antenna 14 and a given mobile terminal 16 comprises a number of downlink propagation paths. These multiple propagation paths, referred to as multipaths, each have characteristic attenuation, phase, and delay attributes, which may be expressed as a complex coefficient representing magnitude and phase, and a corresponding delay attribute. Thus, channel coefficient C_{jk} may be represented by the polynomial $[\mathrm{C}_0 + \mathrm{C}_1 \mathrm{z}^{-1} + \mathrm{C}_2 \mathrm{z}^{-2} + \ldots + \mathrm{C}_{n-1} \mathrm{z}^{n-1}]$

$\underline{\mathrm{C}_0 + \mathrm{C}_1 \mathrm{z}^{-1} + \mathrm{C}_2 \mathrm{z}^{-2} + \ldots + \mathrm{C}_{n-1} \mathrm{z}^{-(n-1)}}$, where C_n represents the channel coefficient associated with a single multipath and z^x is a delay operator that represents the unit delay of the various multipaths relative to the first received multipath. The time delay operator could be expressed relative to a multipath other than the first received multipath, in which case the above expression might include channel coefficients with positive delay elements (e.g., $C_x z^{+4}, C_{x-1} z^{+3}$, and so on).

Amendments to the paragraph beginning on line 12 of page 20.

The IIR processed blocks are then FIR processed by matrix multiplication with the adjoint matrix polynomials to obtain transmit signal blocks. Filter array 32 comprising FIR filters 34 process the IIR-filtered signals to compensate for interference between signals S_1, S_2, and S_3 at the mobile terminals 16. Each signal is processed by a corresponding row of FIR filters 34 in the FIR filter array 32. The output signals from FIR filters 34 are summed down filter array columns, indicated by the + sign at the junction of the line from one output to another.

These summed outputs represent the baseband combined transmit signals relayed by the transmit processor 18 to the modulators [22] 22A ... 22N used to generate transmit signals $T_1 \ldots T_N$, which are in turn transmitted by transmit antennas 14A ... 14N.

Amendments to the paragraph beginning on line 3 of page 22.

Fig. 3 is a flowchart illustrating the operation of the transmit processor 18 located in the network 10 for determining the coefficients of the IIR filters 30 and FIR filters 34 based on channel state information (CSI). Processing begins (block 200) with updating the CSI information [is updated] to reflect latest estimates of the downlink channel z-polynomials comprising the channel estimate matrix C.

Amendments to the paragraph beginning on line 19 of page 23.

When practicing the present invention, it is desirable to group mobile terminals 16 using the same communication channel relative to a group of three neighboring base stations 12. Fig. [11] 5 illustrates the difference between desirable and less desirable groupings. Forming group 1 as comprising the three mobile terminals 16 which are nearest to their respective base stations 12 obtains the most desirable groupings. This can be considered as producing a propagation loss matrix with the least loss along the diagonal. Then group 2 comprises the three mobiles with the second least loss to a respective one of the three base stations; while group 3 comprises the three mobiles with the third lowest loss to their respective base stations, and so on.

Amendments to the paragraph beginning on line 5 of page 33.

Alternatively, the simpler approach of adding flattening or over flattening zeros can be used. In the case of high-Q determinant poles, i.e. roots very close to the unit circle, a flattening zero may be placed exactly over the pole to annihilate it. Instead of adding a zero then, a pole is annihilated from the determinant instead (block 234). On the other hand if one of the L poles closest to the unit circle is a low-Q pole, the attenuation frequency response may not show a peak exactly on the pole frequency but will be displaced due to the influence of the adjoint matrix FIR polynomials. In that case a zero is centered on the displaced peak and does not annihilate the nearby pole (block 236).

Amendments to the paragraph beginning on line 11 of page 34.

Maintaining the simplifying assumption of equal phase and amplitude on all nine paths, the adjoint of this matrix is:

$$\left[\begin{bmatrix} z^{-3}-1 & z^{-3}-z^{-6} & 0 \\ 1-z^{-3} & z^{-2}-z^{-3} & z^{-3}-z^{-2} \\ 0 & z^{-4}-1 & z^{-1}-z^{-5} \end{bmatrix} \qquad \text{(Eq. 15)} \right]$$

$$\begin{bmatrix} z^{-3}-1 & z^{-3}-z^{-6} & 0 \\ 1-z^{-3} & z^{-2}-z^{-3} & z^{-4}-1 \\ 0 & z^{-4}-1 & z^{-1}-z^{-5} \end{bmatrix} \qquad \text{(Eq. 15)}$$

and the determinant polynomial is $-1+z^{-3}+z^{-4}-z^{-7}=-(1-z^{-4})(1-z^{-3})$. The determinant has all seven roots on the unit circle at:

z = 1 (two roots)

z = -1

z = j

z = -j

$z = \exp(j120^0)$

$z = \exp(j240^0)$

Each root represents a frequency at which infinite attenuation can arise between the transmitting system and the mobile terminal 16, so it is inefficient to attempt to convey energy at those frequencies to the mobile terminals 16.

Amendments to the paragraph beginning on line 5 of page 35.

To avoid this problem, all seven roots on the unit circle are optionally annihilated by zeros in the numerator, which is the same as deleting the roots of the determinant. Annihilating all seven roots could cause the equalizers in the mobile terminals 16 to have to deal with an effective channel length (delay) equal to seven symbol periods of delay—keeping in mind that not dividing by one or more factors in the determinant polynomial is the equivalent of multiplying in the numerator by those omitted factors. All the adjoint matrix elements however share at least one root with the determinant that can be annihilated. Canceling the factor $-1+z^{-1}$ from both the adjoint matrix and the determinant polynomial leaves:

$$\left[\begin{bmatrix} (1+z^{-1}+z^{-2}) & -z^{-3}(1+z^{-1}+z^{-2}) & 0 \\ -(1+z^{-1}+z^{-2}) & -z^{-2} & z^{-2} \\ 0 & (1+z^{-1}+z^{-2}+z^{-3}) & -z^{-1}(1+z^{-1}+z^{-2}+z^{-3}) \end{bmatrix} \quad \text{(Eq. 16)}\right]$$

$$\begin{bmatrix} (1+z^{-1}+z^{-2}) & -z^{-3}(1+z^{-1}+z^{-2}) & 0 \\ -(1+z^{-1}+z^{-2}) & -z^{-2} & (1+z^{-1}+z^{-2}+z^{-3}) \\ 0 & (1+z^{-1}+z^{-2}+z^{-3}) & -z^{-1}(1+z^{-1}+z^{-2}+z^{-3}) \end{bmatrix} \quad \text{(Eq. 16)}$$

The determinant is now being $(1 - z^{-4})(1 + z^{-1} + z^{-2})$. Not dividing by the 6th order reduced determinant means that the mobile terminals 16 will receive their signals

modified by a 6th order FIR filter, and their equalizers must be able to deal with 7 symbol periods of delay.

Amendments to the paragraph beginning on line 8 of page 39.

Fig. 6 plots the determinant polynomial and the flattened polynomial obtained by deleting the four roots closest to the unit circle. The coefficients of the example polynomial are given in Table 2 below:

TABLE 2: COEFFICIENTS OF POLYNOMIALS		
COEFFICIENT	REAL	IMAG
A(1)	-0.01492	0.01770
A(2)	0.01484	-0.02824
A(3)	0.02419	-0.08202
A(4)	0.00808	-0.01929
A(5)	-0.04147	-0.15490
A(6)	0.36312	0.11521
A(7)	0.44006	0.19125
A(8)	0.58783	0.88261
A(9)	0.22755	0.01047
A(10)	0.33422	1.09935
A(11)	0.22015	-0.36053
A(12)	-0.67517	0.61808
A(13)	0.15489	-0.26555
A(14)	-0.12943	-0.13633

The roots in Z of the above polynomial were found by the above computer analysis to be:

TABLE 3: ROOTS OF POLYNOMIALS				
[REAL]	<u>REAL</u> [IMAG]	<u>IMAG</u> [|LOGMAGNITUDE|]	<u>|LOGMAGNITUDE|</u>	
ROOT(1)	0.62535	-0.07880	0.46157	
ROOT(2)	0.35251	0.94711	0.01053	DELETE
ROOT(3)	-0.21019	0.26791	1.07728	
ROOT(4)	0.47505	1.6884	0.56192	
ROOT(5)	-0.57159	0.7985	0.01816	DELETE
ROOT(6)	-1.07257	0.84329	0.31070	
ROOT(7)	-1.76889	0.60238	0.62521	
ROOT(8)	0.34753	-0.64730	0.30831	
ROOT(9)	-1.10402	-0.95889	0.38001	

ROOT(10)	-0.34591	-1.29541	0.29327	DELETE
ROOT(11)	0.22513	-1.10904	0.12369	DELETE
ROOT(12)	1.95558	-0.38249	0.68946	
ROOT(13)	2.43781	-0.97210	0.96488	

The four roots of magnitude closest to unity were determined by comparing the values of ABS(REAL(CLOG(ROOT(I)))), where the complex logarithm function "CLOG" returns a real part equal to the logmagnitude. Thus, the preceding expression returns the absolute value of the real portion equal to the logmagnitude of the complex value. The roots with the smallest absolute value of this logmagnitude are ROOT(5), ROOT(2), ROOT(11) and ROOT(10) and were deleted to produce the flattened curve of the reduced determinant.

Amendments to the paragraph beginning on line 20 of page 40.

The nine frequency responses of Figure 7B can also be combined in threes by adding their power responses to determine how much power in total is being used to transmit to each mobile terminal 16, as shown in Figure [8C] 7C. The integral of the power spectral curves yields the total power used for transmitting the intended signals to each mobile terminal 16. These powers can be compared to the powers that would have been necessary to communicate the same total signal power to one mobile terminal 16 at a time from the best base station 12 with the same channel state to obtain the comparative gain or loss for the macrodiversity network 10. In the above case, the results were:

Mobile 1: +4.46dB more power needed (a loss)

Mobile 2: +0.98dB more power needed (a loss)

Mobile 3: +2.50dB more power needed (a loss)

The net loss is less than appears, because the mobile terminals 16 that are relatively nearer their supporting base stations 12 receive the significantly increased power while those further away receive smaller power increases.